CPD

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The art and science of aesthetic dentistry. Part two: treatment of the crowded anterior dentition - a step-by-step protocol

In this second part of his series, Paul Tipton looks at anterior crowding

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INTRODUCTION

The success of aesthetics and restorative dentistry depends upon the clinician's understanding of natural tooth form. Recent advances in adhesive dentistry, dental materials and dental technology have increased the ability of the clinician to mimic the natural dentition. In patients who are dissatisfied with the appearance of crowded teeth, orthodontics is the ideal treatment. However, in some of these cases patients are not prepared to go forward with this treatment due to time constraints and quicker restorative modalities are requested that require a combination of smile analysis, diagnostic procedures, gingival contouring and tooth preparation techniques, but always visualising the end result for success.

SMILE DESIGN

Technical advances in dental ceramics throughout the last 15 years have allowed ceramists to fabricate restorations that approach the aesthetics of the natural dentition (Kelly, Mishimura & Campbell, 1996). However, achieving this aesthetic improvement in the mouth also needs the clinician to visualise the end result that is the beauty of the natural dentition (Winter, 1993). In order to visualise the end result the diagnostic wax up, provisional restoration and tooth preparation guide (Shavell, 1994) are essential components. The principle elements in achieving a pleasing and aesthetic smile is based on 'smile design' (Morley & Eubank, 2001). This involves creating an incisal plane parallel to the eyes (Roach, 1988) and curving upwards to mimic the lower lip during smiling (Chiche & Pinault, 1994). The starting point of the aesthetic treatment plan is often the mid-line (Spear, 1999) although subtle changes are permissible as one moves further laterally away from the centreline. All of these aspects have been covered in Part 1 of this series.

ANTERIOR CROWDING

Although greater numbers of adults are undergoing orthodontic procedures for aesthetic correction of anterior crowding than in previous years, a significant proportion of this patient population remains opposed to such treatment. An orthodontic solution, although ideal, may nonetheless be rejected by the patient even though ceramic brackets, as well as lingual orthodontic appliances have minimised the unaesthetic appearance of the modality. Numerous patients continue to select restorative treatment as a quicker alternative to time-consuming orthodontics.

If non-orthodontic realignment is requested, the patient should be informed of the potential limitations and must understand that the definitive results may be a compromise being less than ideal from an aesthetic and functional standpoint. If an optimal smile can be achieved by orthodontic means, the patient should be strongly advised that this is the treatment of choice. The following case studies illustrate patients who were dissatisfied with the appearance of their crowded teeth and had refused orthodontic treatment several times before being referred for a specialist restorative solution. The same smile design principles and treatment planning procedures are adapted for all these cases to ensure a final predictable aesthetic end result.

Figure 1: Initial presentation and smile

Figure 2: Close-up of the smile showing crooked front teeth

Figure 3: Close up retracted view

Figure 4: Diagnostic wax-up

Figure 5: Prototype acrylic restorations

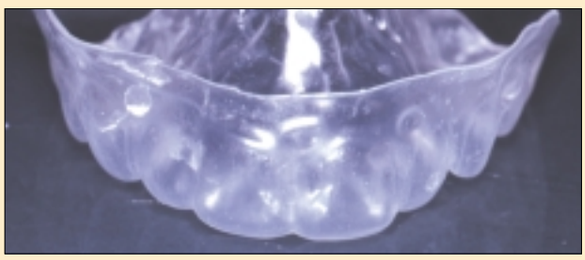

Figure 6: Preparation guide

PORCELAIN VENEERS

Numerous studies have shown the excellent success rates for porcelain veneers (Calamia, 1989; Calamia, 1993; Garber, 1993). Based on these results, the range of indications has increased to include fractured teeth (Andreasen et al, 1991), worn down anterior dentitions (Walls, 1995a & 1995b), diastema closure (Tipton, 2001) and treatment of crowding (Shannon, 1999). Preparations for veneers should usually cross the incisal edge for strength and control stress distribution (Highton et al, 1987) and finish with a mini chamfer on the palatal surface after a 1.5mm reduction of the incisal edge (Belser et al, 1997). This extension onto the palatal surface creates composite bonds at right angles to the direction of displacement of the veneer during the initial phases of protrusive movements along the palatal-incisal area of the tooth (Garber, 1993). Interdental preparations have involved preparations up to and half way into the contact areas (Belser et al, 1997) for minimal preparation techniques. However, when major changes in form are required as in the case of crowded teeth wrapping around both incisally and interdentally is recommended (Belser et al, 1997; Rouse, 1997). The interproximal margins are extended in a palatal direction beyond the interproximal contact points allowing the ceramist maximum opportunity to create correct aesthetic form and function.

CASE STUDY 1

This young lady (Figure 1) was referred to St Ann's Dental Clinic by her general dental practitioner in St Helens. She was unhappy about the appearance of her smile (Figure 2) due to the crowding of her maxillary anterior teeth (Figure 3). Orthodontics was offered but refused by that patient due to the time required to complete treatment. The initial diagnostic phase included mounted study casts and diagnostic waxing (Figure 4) to envisage the final end result. Periodontal surgery by way of crown lengthening to even the gingival margin alignment was also refused, again due to a time basis. Upon verification of the final shape, length and appearance of the wax-up, prototype restorations (Figure 5) and preparation guides (Figure 6) were prepared ready for the preparation stage.

Veneer preparations were

Figure 7: Tooth preparation showing incisal edge reduction using prep guide on central incisor tooth

Figure 8: Tooth preparation on right central incisor tooth with prep guide

Figure 9: Final preparations prior to dentine bonding

performed on the upper right central lateral and canine teeth and the upper left central incisor using the preparation guide (Figures 7 to 9). Upon formalising the preparations and prior to the impressions, the remaining dentine was sealed with one-step bonding system (Optident). Impressions were taken after light pumicing of the teeth to remove the surface oxygen inhibition layer of composite which could interfere with set of the impression material (Provil and Monophase – Heraeus Kulzer). Acrylic prototype restorations shaped to the final shape and form were cemented with 'Temp Bond Clear' (Kerr).

All-ceramic porcelain restorations etched restorations, fabricated by the dental technician and etched on the fit surface with hydrofluoric acid, were tried in prior to cleaning with phosphoric acid to remove all debris and saliva and silaning with 'Silicoup' (Heraeus Kulzer) to increase the bond strength of composite to the etched porcelain fit surface. The veneers were then cemented with one-step bonding system (Optident) and Nexus 2 composite luting cement (Kerr) using rubber dam and isolating from the left canine to the right second premolar.

The final aesthetic result (Figures 10 to 13) shows harmony between the veneers and the contra-lateral natural teeth

Figure 10: Completed veneers

Figure 11: Close-up of final smile

Figure 12: Close-up of final restorations

Figure 13: Final smile

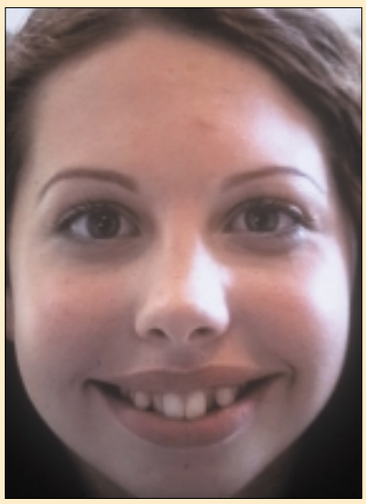

Figure 14: Patient's unattractive smile

Figure 15: Close-up view of imbricated anterior teeth (anterior view)

Figure 16: Left lateral view

Figure 17: Right lateral view

CASE STUDY 2

This young girl was referred to St Ann's Dental Clinic by her general dental practitioner in Liverpool after refusing to undergo orthodontic treatment to correct her severe maxillary anterior crowding (Figures 14 to 17). Standard diagnostic procedures were undertaken prior to starting treatment, including mounted study casts, diagnostic wax-up (Figure 18), tooth preparation guides (Figures 19 & 20) and prototype restorations. The goal of treatment was to correct anterior crowding by means of etched porcelain restorations and soft tissue gingival reshaping.

TOOTH PREPARATION

It is advisable that the dentist first makes the anticipated diagnostic preparations on study casts, to ensure that all aspects of preparation design be realistic and accurate. Teeth that are rotated labially must be prepared so that the labial height of contour of the preparation is in arch-form alignment with the adjacent preparations. It is equally critical to open up the interproximal aspect of the preparation on the surface that is labially placed. This allows adequate clearance for porcelain application to create the illusion of proper alignment as viewed from the front. The goal of tooth preparation in these cases is to 'orthodontically' align all the preparations making it easier for the technician to achieve the ultimate aesthetic result.

Tooth preparation started with conventional veneer preparations using supragingival margins to the labial surfaces of the two central incisors as the position of these two teeth were deemed ideal. Incisal reduction was 1.5mm with heavier tooth preparation on the distal aspect in the form of slice preparation so as to open up this area to allow the lateral incisors to come forward. Tooth preparation for both lateral incisors included heavy 2mm palatal preparation, and minimal labial reduction apart from a 0.5mm gingival finishing line. Both canines, which were initially outstanding from the arch, were prepared with a 2.2mm labial reduction (Shillingburg & Grace, 1973) so as to avoid exposure. In this way,

Figure 18: Diagnostic wax-up

Figure 19: Preparation guide on model

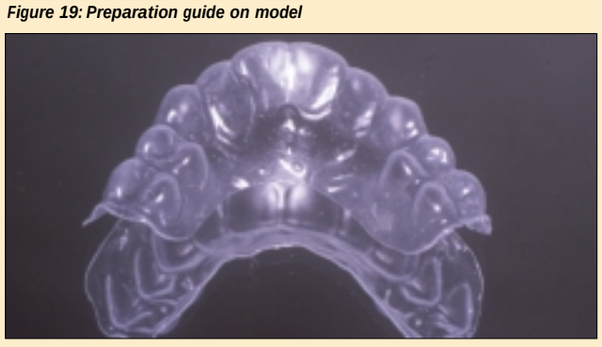

Figure 20: Preparation guide

Figure 21: Tooth preparation

Figure 22: Left lateral view

Figure 23: Right lateral view

by the attachment of 0.5mm etched porcelain restorations, the canines could be moved more palatally and the lateral incisors moved more buccally into perfect alignment. In order to move the upper left lateral incisor forwards, as well as heavy preparation on the distal aspect of the left central incisor, the mesial aspect of the upper left canine was also heavily prepared so as to allow this forward movement of the lateral incisor (Figures 21 to 23). Provisional restorations made from the diagnostic wax-up in composite were then relined using 'Prevision' (Heraeus Kulzer) and cured directly onto the tooth preparations with no intervening dentine bond after the dentine had been sealed by the use of Gluma desensitiser. The shrinkage of the 'Prevision' composite is adequate to hold the provisional restorations in place on the prepared teeth for up to 10 days whilst the definitive restorations are made. To avoid blackening of the prototype veneers, the patient is instructed to avoid alcohol and use carbamide peroxide around the gum margin by rubbing with a cotton bud.

SOFT TISSUE RESHAPING

The palatal displacement of the lateral incisors meant that the soft tissues over the gingival margins of these teeth were at a lower level than the adjacent central incisors and canines. The bone was sounded by periodontal probing in the sulcus to establish whether gingivectomy (soft tissue removal) or periodontal flap surgery and bone contouring was appropriate. There was excess soft tissue present and therefore gingivectomies were performed on the labial aspects of the upper lateral incisors to bring their gingival margins into a more perfect alignment with the centrals and canines.

TECHNICAL PROCEDURES

Technical procedures followed which included production of a Geller model (Willer Geller) with removable stone dyes in a acrylic model (Figures 24 & 25). This allowed guided soft tissue sculpturing of the interdental papillae by preparation of the acrylic model so as to eradicate any black triangles in the final

Figure 24: Geller Model – occlusal view showing extent of preparations on the palatal aspects

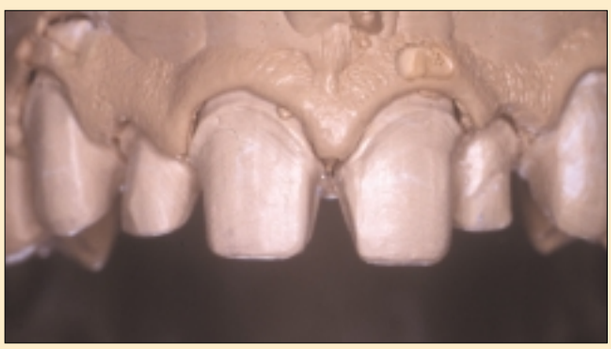

Figure 25: Anterior view

Figure 26: Porcelain restorations on the model – anterior view

Figure 27: Left lateral view

Figure 28: Right lateral view

Figure 29: Occlusal view

restorations (Bichacho, 1996) (Figures 26 to 29). Contact areas between these restorations were carefully planned so that the coronal aspects of the contact area was no greater than 5mm from the interdental bone.This was accomplished by probing the interdental bone between preparations and measuring the distance from the incisal edge of the adjacent preparation to the interdental crest of bone. The technician was then in a position to form his contact areas 5mm incisal to the interdental crest of bone. The technician was then in a position to form his contact areas 5mm incisal to the interdental bone crest to eliminate any potential black triangles (Tarnow et al, 1992). In order to recreate the same emergence profile for both lateral incisors the neck of the upper left lateral incisor was deliberately over-contoured so that the necks of both lateral incisors were now in the same horizontal plane (Figure 30) making for a more pleasing appearance as the soft tissue settled into the area.

The all-ceramic restorations were made of vita porcelain and were bonded onto the teeth using several coats of 'One Step' dentine bonding system (Optident) and Nexus 2 light curing composite luting cement (Kerr) and after acid etching the remaining enamel for 30 seconds and dentine for 15 seconds, drying to assess the enamel etch pattern and rehydrating with 'Tublicid' antimicrobial wetting agent impregnated with fluoride (Fielding Dental). Immediately after fitting of the restorations, however, there appeared a loss of interdental papillae on the upper left side between the central and lateral incisors

Figure 30: Left lateral incisor restoration showing over-contoured emergence profile (lateral view)

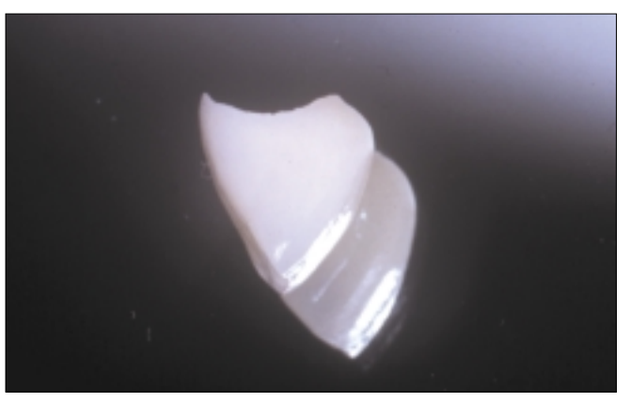

Figure 31: Definitive porcelain etched restorations fitted in mouth (anterior view) – showing loss of interdental papilla between left central and lateral incisors

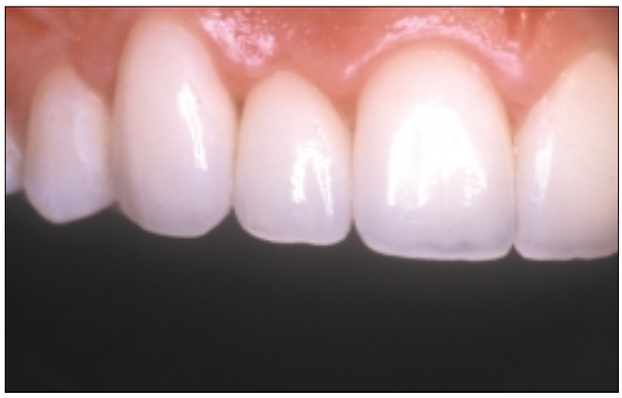

Figure 32: Final right lateral view

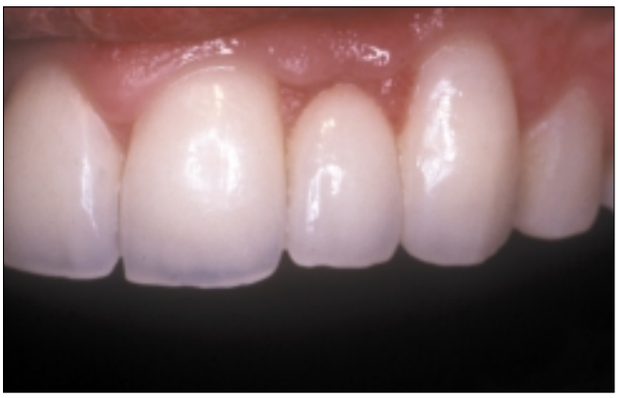

Figure 33: Left lateral view showing initial infill of interdental papilla

Figure 34: Left lateral view three months later showing maturation of interdental papilla

(Figure 31) whilst the right side showed no loss of tissue (Figure 32). However, this papillae was expected to fill in according to Tarnow et al (1992) and the correct placement of the contact area. One month after the restorations were fitted, soft tissue ingrowth is visible (Figure 33 & 34). Three months later after review, a full interdental papillae can be seen once the soft tissue has matured.

CONCLUSIONS

The final end result fulfils all the requirements of an aesthetic restoration in that it is pleasing in appearance, easily cleansible, allowing good periodontal health and maintenance (Figures 35 & 36). The aesthetic correction in such areas where orthodontics is not performed relies on a combination of tooth preparation techniques, knowledge of tooth anatomy and dentine adhesion, excellent technical support and determination of bone levels in conjunction with correct contact area placement.

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Figure 35: Final aesthetic anterior view showing infill of interdental papilla – not as yet mature

Figure 36: New smile

REFERENCES

Andreasen F, Daugaard-Jensen J, Munksgaard E (1991). Reinforcement of bonded crown fractured incisors with porcelain veneers. *Endod Dent Traumatol* **7:** 78-83

Belser U, Magne P, Magne M (1997). Ceramic laminate veneers: continuous evolution of indications. *J Esthet Dent* **9:** 197-207

Bichacho N (1996). Cervical contouring concepts: enhancing the dento-gingival complex. *Pract Period Aesthet Dent* **8:** 241-254

Calamia J (1989). Clinical evaluation of etched porcelain veneers. *Am J Dent* **2:** 9-15

Calamia J (1993). The current status of etched porcelain veneer restorations. *J Indiana Dent Assoc* **72:** 10-15

Chiche G, Pinault A (1994). *Esthetics of Anterior Fixed Prosthodontics*. Chicago: Quintessence

Garber D (1993). Porcelain laminate veneers: 10 years later. Part 1: tooth preparation. *J Esthet Dent* **5:** 57-62

Goldstein R (1977). Esthetic principles for ceramo-metal restorations. *Dent Clin N Am* **20:** 803-822

Highton R, Caputo A, Matyas J (1987). A photo-elastic study of stresses on porcelain laminate preparations. *J Prosth Dent* **58:** 157-161

Kelly J, Mishimura I, Campbell S (1996). Ceramics in dentistry. Historical roots and current perspectives. *Prosth Dent* **75:** 18-32

Morley J, Eubank J (2001). Macroesthetic elements of smile design. *J Am Dent Assoc* **132:** 39-45

Roach R (1988). Communications between dentist and technician: an esthetic checklist. In Preston J (ed). *Perspectives in Dental Ceramics*. Proceedings of the Fourth International Symposium on Ceramics. Chicago: Quintessence

Rouse J (1997). Full veneer versus traditional veneer preparation: a discussion of interproximal extension. *J Prosthet Dent* **78:** 545-549

Shannon A (1999). Reconstruction of the maxillary dentition utilising a non-orthodontic technique. *Pract Periodont Aesthet Dent* **13:** 551-555

Shavell H (1994). The periodontal-

restorative interface in fixed prosthodontics. Tooth preparation, provisionalisation and biological final impressions: part one. *Pract Periodont Esthet Dent* **6:** 33-44

Shillingburg H, Grace C (1973). Thickness of enamel and dentine. *J South Cal Dent Assoc* **41:** 33-52

Spear F (1999). The aesthetic management of dental mid-line problems with restorative dentistry. *Compend Contin Educ Dent* **20:** 912-998

Tarnow D, Magner A, Fletcher P (1992). The effect of the distance from the contact point to the crest of bone on the presence or absence of the interproximal dental papilla. *J Periodontol* **63:** 995-996

Tipton P (2001). Aesthetic tooth alignment using etched porcelain restorations. *Pract Proced Aesthetic Dent* **13:** 551-555

Walls A (1995). The use of adhesively retained all-porcelain veneers during the management of fractured and worn anterior teeth. Part 2: clinical results after five year of follow-up. *Br Dent J* **178:** 337-340

Walls A (1995). The use of adhesively retained all-porcelain veneers during the management of fractured and worn teeth. Part 1: clinical technique. *Br Dent J* **178:** 333-336

Winter R (1993). Visualising the natural dentition. *J Esth Dent* **5:** 102-117

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This is one of six articles in this issue which will each be equivalent to one hour of verifiable CPD. See page 73 for application details.

Q1

What criteria are used to design a smile?

a) Incisors parallel to lower lip
b) Incisors parallel to the ground
c) Incisors parallel to eyes

Q2

What is the ideal tooth preparation for veneers?

a) 0.5mm
b) Stay in enamel
c) Design the preparation for the final end result

Q3

How should you treat dentine after tooth preparation?

a) Clean with pumice
b) Wash with water
c) Etch and dentine bond
d) All of the above

Q4

How much dentine and enamel is there in the mid buccal area of an average adult dental tooth?

a) Less than 2mm
b) More than 2mm
c) Exactly 2mm

Q5

What is the Geller model made of?

a) Plaster
b) Acrylic
c) Silver